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RESEARCH ARTICLE

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Global and Regional IUCN Red List Assessments: 14

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Abstract

In this contribution, the conservation status assessment of three vascular plants according to IUCN categories and criteria are presented. It includes the assessment of *Allium ravenii* F.O.Khass., Shomuradov & Kadyrov and *Centaurea seguenzae* (Lacaita) Brullo, Marcenò & Siracusa at global level and *Haloxylon persicum* Bunge ex Boiss. & Buhse at regional level.

Keywords

conservation, extinction risk, IUCN protocol, threats

How to contribute

The text of the global and regional assessments should be submitted electronically to Simone Orsenigo (simone.orsenigo@unipv.it) or to Giuseppe Fenu (gfenu@unica.it); the text, up to 8,000 characters in length (spaces included), must include a distribution map and a picture of the assessed species.

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Red List Assessments

Allium ravenii F.O.Khass., Shomuradov & Kadyrov

Global assessment
Taxonomy and nomenclature
Order: Asparagales *Family*: Amaryllidaceae

Allium ravenii F.O.Khass., Shomuradov & Kadyrov, Stapfia 95: 173 (2011).

Common name: Raven's garlic (En).

Geographic distribution range: *Allium ravenii* (Fig. 1) is a rare species, endemic to plains with gypsum soils adjacent to the Eastern Chink, on the eastern border of the Ustyurt plateau in Karakalpakstan (43.96°N, 58.35°E; Uzbekistan). In the past, this locality was considered the southwestern coast of the Aral Sea. The only one small population known to date is located in the district North-Ustyurt botanical geographical region of the Ustyurt plateau (Fig. 2) of the Turan province (Khassanov 2016). Currently, *Allium ravenii* is known only from the *locus classicus*.

Distribution: *Countries of occurrence*: Uzbekistan.

Biology: *Plant growth form*: Perennial (geophyte).

Flowering and fruiting time: flowering from May to June and fruiting from June to July.

Figure 1. *Allium ravenii* in the plains adjacent to the Eastern Chink. Photograph by Kh. Shomurodov.

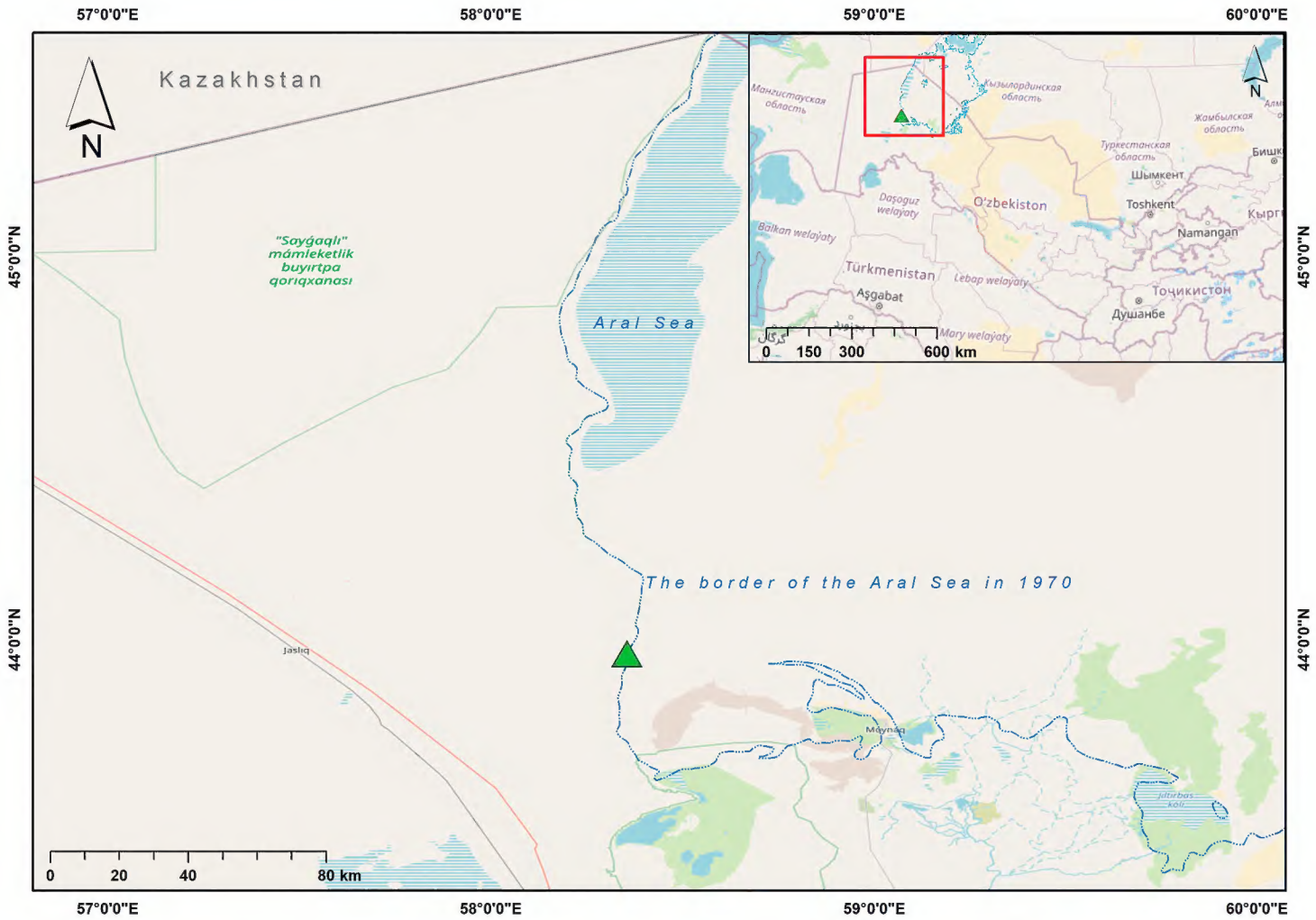

Figure 2. Geographic range and distribution map of *Allium ravenii* in Ustyurt Plateau (Karakalpakstan).

Reproduction: pollination, dispersal mechanism and seed germination have not been studied.

Habitat and ecology: *Allium ravenii* is a geophyte 15–30 cm high (Khassanov et al. 2011), growing on saline plains with gypsum or calcareous soil at an altitude of around 150 m a.s.l., in a windy area with a sharply continental climate. The range of this species is located in an extremely arid zone that is also affected by the effects associated with the drying up of the Aral Sea. The cumulative analysis of the aridity index showed that a single growing trend in the Ustyurt Plateau region is arid warming, accompanied by an increase in moisture deficit, mainly in the spring period of the year (Adilov et al. 2017). This species occurs in community poor in plant species and with low coverage (11–13%) dominated by *Anabasis salsa* (Ledeb.) Benth. ex Volkens, *Anabasis brachiata* Fisch. & C.A.May. ex Kar. & Kir., and *Salsola orientalis* S.G.Gmel.

Population information: continuously updated data on the single population of Raven's garlic are missing. During field research in 2009–2010, about 20 individuals in full bloom were found, while only six plants were recorded during the monitoring expedition in 2015. Probably due to the very dry years (< 75 mm in 2020; data from the Aktumsuk weather station) and the sharp decrease in precipitation in spring, during targeted field studies in the spring of 2020–2021, no individuals were found during the growing season. The declining trend in the number of individuals of this species takes place against the background of the drying of the Aral Sea and the intensification of the process of desertification in the region.

Threats: *2.3 Livestock farming & ranching and 2.3.1 Nomadic grazing*: The Ustyurt Plateau and the Eastern Chink are used as nomadic pastures for sheep, goats and camels. Moreover, also wild animals like *Saiga tatarica* (Linnaeus, 1766) and *Gazella subgutturosa* (Güldenstädt, 1780) graze during all the year.

3.1 Oil & gas drilling: Gas reserves are large on the Ustyurt Plateau and there are several drilling stations around the *Allium ravenii* population.

4.1 Roads & railroads: The population was found on the side of the only road that crosses the plateau towards the Aral Sea. This road is intensively and irregularly used for transportation of tourists and special equipment used by geologists. It is easy to see from satellite images that more than 10 new roads have appeared around the population.

11.2 Droughts: Aridization processes in Uzbekistan are becoming more intense (Khabibullaev et al. 2022), according to the weather stations "Jaslyk", "Kungrad", and "Aktumsuk", which are closest to the *A. ravenii* population area; in recent years, precipitation has been declining, and the increase in average air temperature has had a positive trend. The drying up of the Aral Sea has a strong influence. In this case, the increase in salt storms will also have a negative impact on the population.

11.3 Temperature extremes: An analysis of long-term climatic data showed that the magnitude of air temperature changes has increased significantly both in the cold and in the warm half of the year (Adilov et al. 2017).

CRITERIA APPLIED

Criterion B: **EOO**: 4 km^2 calculated with GeoCAT (Geospatial Conservation Assessment Tool) software (Bachman et al. 2011).

AOO: 4 km^2 calculated with GeoCAT software (Bachman et al. 2011).

a) A single location (unsystematic grazing or climate change).
b) Continuing decline, observed in extent of occurrence, area of occupancy, extent and quality of habitat, number of mature individuals.
c) Extreme fluctuations in number of mature individuals.

Criterion C: Population size estimated in about six mature individuals.
1) An estimated continuing decline of at least 25% within three years or one generation.
2) A continuing decline, observed in numbers of mature individuals and at least 90% of mature individuals in one subpopulation.

Criterion D: Population size estimated in only six mature individuals.

Red List category and Criteria (Global Assessment)

CR	**Critically Endangered**	**B1ab(i,ii,iii,v)c(iv)+2ab(i,ii,iii,v)c(iv)+C1+C2a(i,ii)+D**

Rationale for the assessment: *Allium ravenii* is endemic to the Ustyurt Plateau and currently has a single population with a small number of mature individuals. The

monitoring results of the last decade show that the number of individuals is decreasing, and the quality of the habitat is worsening due to climate change and the ecological crisis of the Aral Sea. In some targeted field trips, no individual was found; however, although failure to find vegetative individuals suggests that this species may meet the criteria for the Extinct (EX) category, the finding of underground parts of several mature individuals in 2015 excludes this category. At the moment, considering the restricted EOO and AOO, and the continuous decline in population size and habitat quality, *Allium ravenii* can be assessed as Critically Endangered (CR) based on criteria B, C, D.

Previous assessment: this species was not evaluated at the global level (IUCN 2022).

Conservation actions: the area where the *A. ravenii* population is distributed is not included in any reserve or protected area. The species is, nonetheless, listed in a national law and in the Red Book of the Republic of Uzbekistan under category 1 (on the brink of extinction) (Kuchkarov et al. 2019). Several important international and local projects are being implemented in the locality to alleviate the problem of the drying up of the Aral Sea and its consequences, and to try to eliminate the ecological crisis ("green covers" in the areas along the Aral Sea, etc.). Within these projects, it is desirable to preserve this endangered species and to create living collections. Through joint projects or articles, it is urgent to make the international community aware of the current status of rare species in Uzbekistan (Kuchkarov et al. 2019).

Conservation actions needed: since it has recently been described and its current distribution may be poorly known, it is necessary to organize targeted field research aimed at searching for new populations of Raven's garlic. It is desirable to search for new methods of conservation of this plant species by biological and ecological studies, and to forecast the future of the species in the context of bioclimatic modeling, besides exploring the possibility of multiplication and translocation to other suitable areas.

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Centaurea seguenzae (Lacaita) Brullo, Marcenò & Siracusa

Global assessment

Taxonomy and nomenclature

Order: Asterales *Family*: Asteraceae

Centaurea seguenzae (Lacaita) Domina, Greuter & Raimondo, Israel J. Plant Sci. 64(1–2): 55 (2017) ≡ *C. todaroi f. seguenzae* Lacaita, Nuovo Giorn. Bot. Ital., n.s. 22: 246 (1915) ≡ *C. todaroi* subsp. *seguenzae* (Lacaita) Giardina & Raimondo, Bocconea 20(10): 393 (2007) ≡ *C. panormitana* subsp. *seguenzae* (Lacaita) Greuter, Med-Checkl. 2: 126 (2008).

Common name: Fiordaliso di Seguenza (It), Seguenza's knapweed (En).

Geographic distribution range: *Centaurea seguenzae* (Fig. 3) is endemic to Sicily and its distribution comprises a single population in the Peloritani mountains

Figure 3. *Centaurea seguenzae* (Lacaita) Brullo, Marcenò & Siracusa from *locus classicus* (Capo Tindari, Sicily). Photograph by S. Cambria.

(NE-Sicily; Fig. 4). As with other *Centaurea* species with a comparable stenochorous geographical pattern (e.g., *Centaurea phalacrica* Brullo, Cambria, Crisafulli, Tavilla & Sciandr. and *Centaurea valdemonensis* Domina, Di Grist., Barone; Brullo et al. 2021; Domina et al. 2022), in Sicily, *C. seguenzae* is confined to a narrow outcrop facing the Tyrrhenian Sea. In fact, this taxon grows exclusively on the rocky slopes of Capo Tindari, near the town of Patti (Messina province). It is spread across windy, rocky ridges close to the sea at an altitude up to 300 m a.s.l. on lithosols composed of Mesozoic marbles and calcium-silicate feldspars. Bioclimatically, according to Pesaresi et al. (2017), this area falls into the lower thermomediterranean thermotype and an upper dry ombrotype.

Distribution: *Countries of occurrence*: Italy (Sicily).

Biology: *Plant growth form*: perennial (chamaephyte).

Chromosome number: $2n = 18$ (Viegi et al. 1972).

Phenology: flowering from May to June, fruiting from July to August.

Reproduction: there is no available detailed information.

Habitat and ecology: *Centaurea seguenzae* grows on coastal rocky cliffs exposed to the wind and is endemic to the Tyrrhenian part of the Peloritani mountains. The habitat in which it grows is mainly characterized by chasmophytes, such as *Erucastrum virgatum* C.Presl, *Dianthus rupicola* Biv. subsp. *aeolicus* (Lojac.) Brullo & Miniss., *Lomelosia cretica* (L.) Greuter & Burdet, *Sedum dasyphyllum* L. and *Teucrium*

Figure 4. Geographic range and distribution map of *Centaurea seguenzae* (Lacaita) Brullo, Marcenò & Siracusa in Sicily (WGS84/Pseudo-Mercator map coordinate reference system).

flavum L. From a phytosociological point of view, the plant community belongs to the *Erucastretum virgati* Brullo & Marcenò, 1979 (*Asplenietea trichomanis* class). This species is also considered characteristic of the sub-association *centauretosum sequenzae* Brullo & Marcenò, 1979 (Brullo et al. 1998).

Population information: The existing population of *Centaurea seguenzae* comprises only a single stand. There is no detailed information available on population dynamics. A rough count of the currently known population of Capo Tindari showed a total of more than 250 mature individuals. However, because the cliffs where the plants grow are generally inaccessible, the total number of individuals might be underestimated. Based on direct observation, the overall trend in population size and number of mature individuals has not shown a significant decrease in the last few years.

Threats: *7.1 Fire and fire suppression*: the relatively inaccessible habitat faces threats of potential fires that can result from natural causes, human-caused accidents, or deliberate acts of arson. In fact, the Messina province, as well as the surrounding territories of Patti and Tindari, are periodically impacted by arson.

8.1 Invasive non-native/alien species: the rocky cliffs on which *C. seguenzae* grows are invaded by a large population of *Opuntia ficus-indica* (L.) Mill., which restricts the growing environment of the species. Currently, the lack of targeted management has led to a decrease of suitable sites for *C. seguenzae*, causing an uncontrolled spread of *O. ficus-indica* and, at the same time, a continuous decline of the habitat quality.

10.3 Landslides: the rocky cliffs are high susceptible to landslides and natural erosion; Capo Tindari is subject to continuous detachment of single blocks and also to the formation of small and massive landslides, like the one in the spring of 2009 near the Verde lagoon (Privitera and Torre 2011).

CRITERIA APPLIED:
Criterion B: **EOO:** 4 km^2
AOO: 4 km^2 calculated with GeoCAT (Geospatial Conservation Assessment Tool) software (Bachman et al. 2011).

a) Number of locations: the species is exclusively found in one location, and the two major threats are the occurrence of invasive alien species and landslides.
b) Decline in quality of the habitat (iii).

Red List category and Criteria (Global Assessment)

CR	**Critically Endangered**	**B1ab(iii)+2ab(iii)**

Rationale for the assessment: *Centaurea seguenzae* is a narrow endemic to Sicily. Specifically, it grows on the vertical cliffs of Capo Tindari, and several threats are expected to have a negative impact on the population dynamics in the near future. Despite the small size of the population and the location of most individuals in inaccessible areas, the population is threatened by the occurrence of invasive alien species and landslides, which determine a continuous decline in habitat quality and population area. Considering that the Area of Occupancy (AOO) is 4 km^2 this species may be assessed as Critically Endangered (CR) at the global level according to criterion B.

Previous assessment: This plant was previously assessed as Near Threatened at the global level (NT; Orsenigo et al. 2018; Rossi et al. 2020).

Conservation actions: The population falls within a Special Area of Conservation (SAC) belonging to the Natura 2000 network, namely "Laguna di Oliveri - Tindari" (code ITA030012). In addition, *Centaurea seguenzae* was one of the target species of the SiMaSeed project funded by the Interreg Italy-Malta 2014–2020 programme (Priority Axis III – Protecting the environment and promoting the efficient use of resources. Specific Objective 3.1). Genetic material, both living plants and seeds, are preserved *ex situ* at the seed bank of Catania University (BGS-CT); so far, over 8,000 seeds were stored (accession number SiMaSeed/CT/19/370).

Conservation actions needed: To better understand the reproductive biology and population trend of the species and to analyze the effects of human activities on the population, particularly those located in tourist areas, it is advisable to conduct further research and implement a monitoring program. Moreover, in order to protect the native growth habitat of the species, management of invasive alien plant species is urgently required.

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Haloxylon persicum Bunge ex Boiss. & Buhse

Regional assessment (Iraq)
Taxonomy and nomenclature
Order: Caryophyllales *Family*: Amaranthaceae

Haloxylon persicum Bunge ex Boiss. & Buhse, Nouv. Mém. Soc. Imp. Naturalistes Moscou 12: 189 (1860) = *Anabasis saxaul* Fisch. ex Ulbr. Nat. Pflanzenfam., ed. 2 [Engler & Prantl] 16c: 572, in syn. (1934) = *Arthrophytum arborescens* Litv. Trav. Mus. Bot. Acad. Petersb. 11: 44 (1913).

Common name: White Saksaul (En), Ghada (Arabic).

Geographic distribution range: *Haloxylon persicum* (Fig. 5) is a small tree, widespread in arid areas extending from Egypt to China. It is an Irano-Turanian species that apparently originated in Central Asia, where it is an important component of the desert vegetation (Mandaville 1986). In Iraq, only two small populations are present, located in the southern desert within the administrative borders of Al-Muthanna Governorate (Fig. 6). The first site (Busayyah) includes the largest number of trees, which form a 45-km-long strip in an approximately north-south direction, *ca.* 100 km south of Al-Nasiriya City, the capital of Dhi Qar Governorate. The second one (Qusair site) is located about 72 km southwest of the center of Dhi Qar Governorate, and 20 km south of Hammar Marsh.

Distribution: *Countries of occurrence*: Afghanistan, China, Egypt, Iran, Iraq, Jordan, Kazakhstan, Pakistan, Palestine, Qatar, Saudi Arabia, Tajikistan, Turkmenistan, United Arab Emirates, Uzbekistan.

Biology: *Plant growth form*: Tree (nanophanerophyte).

Flowering and fruiting time: *Haloxylon persicum* flowers from March to April.

Reproduction: no information on pollination and dispersal strategies is available. This species can reproduce vegetatively. In the laboratory, the optimum temperature for seed germination is 20–25 °C (100% germination), and each further increase in temperature decreases the percentage of germination (Al-Khalifah and Shanavaskhan 2007).

Habitat and ecology: *Haloxylon persicum* is a xerophytic desert plant native to sandy deserts in Central Asia, the Middle East, Afghanistan, north-western China, and Near Eastern deserts (Al-Khalifah and Shanavaskan 2007). It is often selected for the restoration of vegetation cover in arid and semiarid regions and deserts of the Irano-Turanian region, including Iran, Iraq, and Afghanistan (Abdi et al. 2019). The mean life span of *H. persicum* is between 15 and 25 years. This species tolerates high temperature and droughts and can be used for livestock feed and firewood, sand dunes stabilization, soil conservation, carbon sequestration, and erosion control in arid lands (Loni et al. 2017; Abdi et al. 2019). In Iraq, both sites are characterized by sandy dunes that are colonized by only a few plants, the most important of which is *Calligonum comosum* L'Hér. There are no temporary water courses in the two areas and the main source of water is rain, which has an annual rate of 93 mm. The plant is distributed in small, scattered groups, and to the best of our knowledge there are no plants cultivated *ex situ* in Iraq.

Figure 5. *Haloxylon persicum* at Busayyah site (Iraq). Photograph by Mohmmad K. Mohammad.

Population information: There is no information on population size and trend at a global level for this widespread species. Currently, it is declining in parts of its range (Oldfield 2020) as in Iraq, where only two small populations remain. Until recently, this plant was very common in this country (Thalen 1979) and a dramatic decline in the number of individuals was observed only in the last decade. This sudden drop was caused by a change in the Bedouin tribal customs and traditions; in fact, while in the past the Bedouins used branches or stems of this plant for their fuel needs thereby safeguarding the trees, currently there are groups of people cutting the roots of *Haloxylon persicum* to smoke the hookah. Large (adult) trees are preferred by collectors. During the last monitoring, only 1,222 juvenile plants were counted in Iraq, 356 of them in the population near the Hammar Marsh and the remaining 866 in the second population.

Threats: *2.3 Livestock farming & ranching*: Camel, sheep and goat grazing is one of the most powerful threats to *Haloxylon persicum* both for nomadic owners (*2.3.1 nomadic grazing*) and the local farmers (*2.3.2 small-holder grazing, ranching or farming*).

4.1 Roads & railroads: the main routes for the local residents of the Bussiya Village pass beneath *H. persicum* stands; although the traffic is light, the routes are not paved and, since the soil surface is very fragile, the traffic causes dense dust that damages the trees.

5.2 Gathering terrestrial plants - 5.2.1: intentional use: intensive logging is one of the major threats: *H. persicum* wood is one of the finest types of firewood as it burns

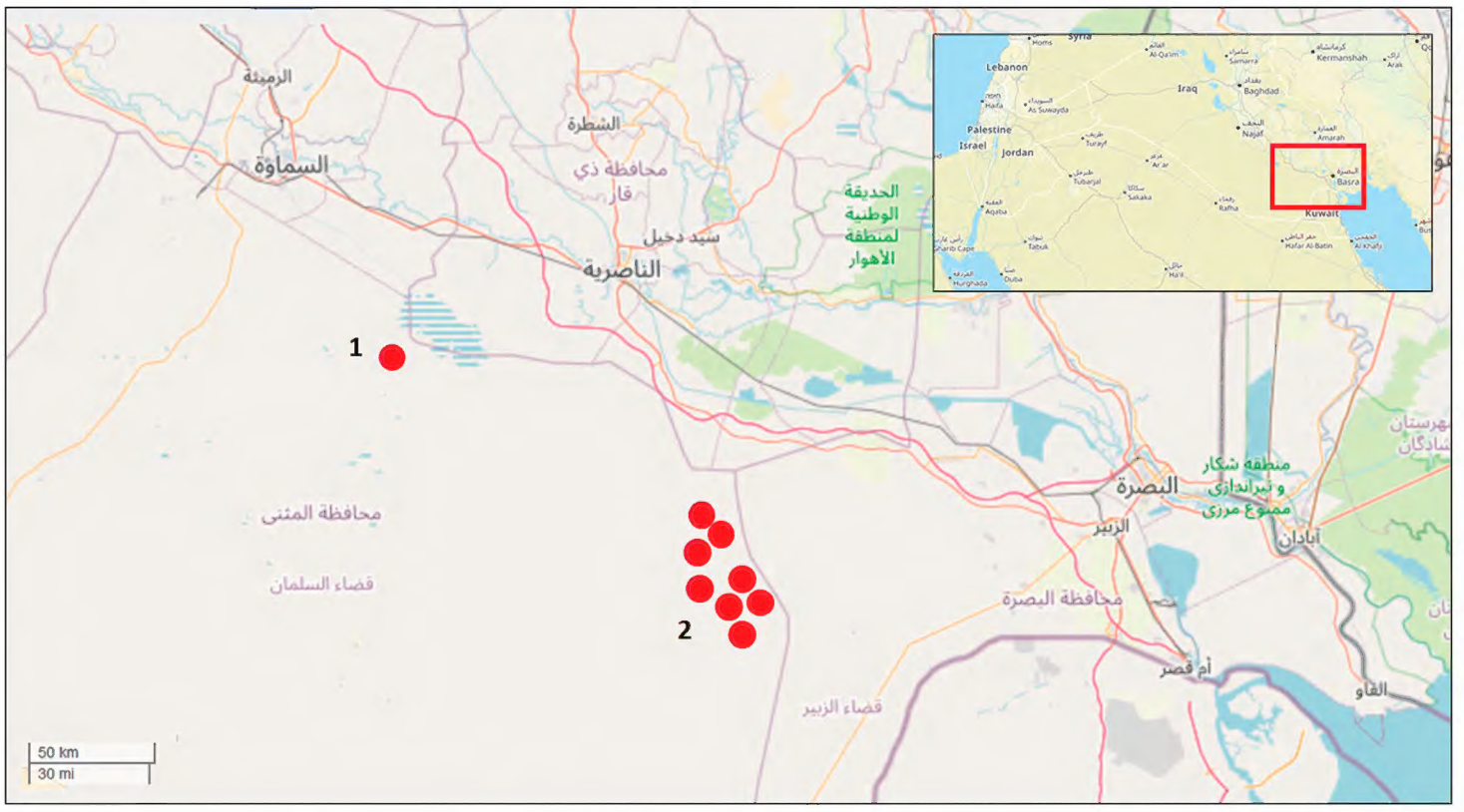

Figure 6. Geographic range and distribution map of *Haloxylon persicum* in Iraq: 1 – Qusair site, located about 20 km south of Hammar Marsh; 2 – Busayyah site, located 100 km south of Al-Nasiriya City.

for a longer time than other types, consequently it is targeted by firewood traders for private use in hookah smoking.

6.1 Recreational activities: during the winter Gulf festivals, local residents camp in the area causing damage to the *H. persicum* trees. In addition, tourists usually go to the area with off-road vehicles, causing habitat degradation; they also cut the plants for firewood and other camping purposes.

11.2 Droughts: the whole area has experienced three consecutive years of severe drought; the driest region of Iraq is located near Nasiriya, which is only about 72 km from the study area.

11.3 Temperature extremes: The southern desert regions of Iraq are known for severe continental climatic extremes. The hottest temperature measured from 1949 to March 2022, 53.8 °C, was reported by the Basrah Airport weather station, not far from the population's growth area. The lowest temperature, reported by the weather station of Samawa (6 m a.s.l.), was -13.8 °C in January 2020. The combination of these extreme temperatures is expected to have a negative effect on the *Haloxylon persicum* populations.

CRITERIA APPLIED:

Criterion B: **EOO**: 1,084.96 km^2 calculated with GeoCAT (Geospatial Conservation Assessment Tool) software (Bachman et al. 2011).

AOO: 136 km^2 calculated with GeoCAT software (Bachman et al. 2011).

a) Iraqi populations are highly fragmented.

b) Continuing decline, observed in extent of occurrence, area of occupancy, extent and quality of habitat, number of locations and subpopulations, and number of mature individuals.

Criterion C: the Iraqi population, in continuous decline, currently does not include any mature individual, but it is composed of 1,222 juvenile plants; no subpopulation has more than 1,000 mature plants.
Criterion D: the Iraqi population includes no mature individual.

Red List category and Criteria (Regional Assessment)

CR	**Critically Endangered**	**C2a(i) + D**

Rationale for the assessment: *Haloxylon persicum* is a widespread tree in arid areas from Egypt to China. Currently, it is declining in parts of its range as in Iraq, where only two small populations remain. In recent years, the Iraqi population has experienced a dramatic decline in the number of mature individuals mainly caused by indiscriminate withdrawal. Currently, there are only 1,222 juvenile plants split into two fragmented populations, exposed to severe threats. Climate change is projected to further reduce the available habitat of this restricted species. According to criteria C and D, *Haloxylon persicum* can be assessed as Critically Endangered (CR) at a regional level.

Previous assessment: this species was evaluated as Least Concern (LC) at the global level (Oldfield 2020). At a regional level, *Haloxylon persicum* is recorded as Vulnerable in China and Jordan, and Endangered in Egypt (BGCI 2018). It was also assessed as Endangered in the UAE at a National Red List Workshop held in 2019.

Conservation actions: there are currently no protection or conservation measures in place for this species in Iraq.

Conservation actions needed: Research and monitoring programmes are recommended in order to investigate the population dynamics of this species. In addition, as proposed for other threatened plants in the area (Mohammad et al. 2022), *in situ* and *ex situ* conservation measures are suggested for potential plant translocation programmes, with the goal to increase the low number of individuals in the population. In addition, an awareness programme for the local population (especially young people) should accompany all these measures.

Note: The issue of conservation for this plant is mainly social, legal, and linked to tribal customs and traditions. In interviews, local resident said that *H. persicum* may reach up to 5 m in height, and can provide shade for up to four camels under its canopy; the present juvenile plants are from 0.4–0.7 m to *ca.* 1.6 m tall. Loggers cut the stem close to the ground, then tie a rope around the root system and pull it by car, thus compromising also the plant's vegetative reproduction. The roots are used in the hookah because they burn for a long time and give a pleasant smell.

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